10/750868

Refine Search

Search Results -

Terms	Documents
L6 and (diagnos$ or analy$)	3

Database: US Pre-Grant Publication Full-Text Database; US Patents Full-Text Database; US OCR Full-Text Database; EPO Abstracts Database; JPO Abstracts Database; Derwent World Patents Index; IBM Technical Disclosure Bulletins

Search: L7

Refine Search | Recall Text | Clear | Interrupt

Search History

DATE: Sunday, November 13, 2005 Printable Copy Create Case

Set Name side by side	Query	Hit Count	Set Name result set
DB=PGPB,USPT; THES=ASSIGNEE; PLUR=YES; OP=OR			
L7	L6 and (diagnos$ or analy$)	3	L7
L6	L5 and (record$ with (fault$ or error$))	4	L6
L5	L4 and (correct$ with (step or act$))	113	L5
L4	701/3,10,14,7,8.ccls.	1223	L4
DB=USPT; THES=ASSIGNEE; PLUR=YES; OP=OR			
L3	L1 and (correct$ with act$)	1	L3
L2	L1 and (aircraft or airplane)	2	L2
L1	6115656.pn. or 6757668.pn.	2	L1

END OF SEARCH HISTORY

Hit List

First Hit | Clear | Generate Collection | Print | Fwd Refs | Bkwd Refs | Generate OACS

Search Results - Record(s) 1 through 3 of 3 returned.

☑ 1. Document ID: US 20030191563 A1

Using default format because multiple data bases are involved.

L7: Entry 1 of 3 File: PGPB Oct 9, 2003

PGPUB-DOCUMENT-NUMBER: 20030191563
PGPUB-FILING-TYPE: new
DOCUMENT-IDENTIFIER: US 20030191563 A1

TITLE: Method and apparatus using historical data to associate deferral procedures and fault models

PUBLICATION-DATE: October 9, 2003

INVENTOR-INFORMATION:

NAME	CITY	STATE	COUNTRY
Eagleton, Stephen P.	Chandler	AZ	US
Felke, Timothy J.	Glendale	AZ	US

US-CL-CURRENT: 701/29; 701/3

Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments | Claims | KWIC | Draw D

☑ 2. Document ID: US 6745010 B2

L7: Entry 2 of 3 File: USPT Jun 1, 2004

US-PAT-NO: 6745010
DOCUMENT-IDENTIFIER: US 6745010 B2

TITLE: Wireless, frequency-agile spread spectrum ground link-based aircraft data communication system with wireless unit in communication therewith

Full | Title | Citation | Front | Review | Classification | Date | Reference | Claims | KWIC | Draw D

☑ 3. Document ID: US 6725137 B2

L7: Entry 3 of 3 File: USPT Apr 20, 2004

US-PAT-NO: 6725137
DOCUMENT-IDENTIFIER: US 6725137 B2

TITLE: Method and apparatus using historical data to associate deferral procedures and fault models

Clear | Generate Collection | Print | Fwd Refs | Bkwd Refs | Generate OACS

Terms	Documents
L6 and (diagnos$ or analy$)	3

Display Format: - Change Format

Previous Page Next Page Go to Doc#

L7: Entry 2 of 3 File: USPT Jun 1, 2004

US-PAT-NO: 6745010
DOCUMENT-IDENTIFIER: US 6745010 B2

TITLE: Wireless, frequency-agile spread spectrum ground link-based aircraft data communication system with wireless unit in communication therewith

DATE-ISSUED: June 1, 2004

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
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ASSIGNEE-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY	TYPE CODE
Harris Corporation	Melbourne	FL			02

APPL-NO: 10/338426 [PALM]
DATE FILED: January 8, 2003

PARENT-CASE:
RELATED APPLICATIONS This application is a continuation of Ser. No. 09/723,340, filed Nov. 27, 2000, now U.S. Pat. No. 6,522,867, which is a continuation-in-part of Ser. No. 09/474,894 filed on Jun. 2, 1999, now issued U.S. Pat. No. 6,154,637, which is a continuation of Ser. No. 08/557,269, filed Nov. 14, 1995, now issued U.S. Pat. No. 6,047,165.

INT-CL: [07] H04 B 7/00, G08 B 21/00

US-CL-ISSUED: 455/66.1; 455/67.1, 455/431, 701/14, 701/35, 340/825.69, 340/825.72, 375/219
US-CL-CURRENT: 455/66.1; 340/825.69, 340/825.72, 375/219, 455/431, 455/67.11, 701/14, 701/35

FIELD-OF-SEARCH: 455/66, 455/67.1, 455/73, 455/431, 455/66.1, 455/67.11, 340/945, 340/961, 340/971, 340/825.69, 340/539.1, 340/825.72, 340/3.3, 340/3.31, 340/3.32, 375/219, 375/130, 375/200, 375/220, 701/14, 701/35

PRIOR-ART-DISCLOSED:

U.S. PATENT DOCUMENTS

Search Selected Search ALL Clear

PAT-NO	ISSUE-DATE	PATENTEE-NAME	US-CL

☐	4642775	February 1987	Cline et al.	364/443
☐	4729102	March 1988	Miller, Jr. et al.	364/424
☐	4872182	October 1989	McRae et al.	375/1
☐	5022024	June 1991	Paneth et al.	370/50
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☐	6522867	February 2003	Wright et al.	455/66.1

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FOREIGN-PAT-NO	PUBN-DATE	COUNTRY	CLASS
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2 276 006	September 1994	GB	

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Gate-Aircraft Terminal Environment Link (Gatelink)--Ground Side, ARINC Specification 632, Dec. 30, 1994.
Airlines Electronic Engineering Committee Letter 91-079/DLK-391, Apr. 5, 1991.
Gate-Aircraft Terminal Environment Link (Gatelink)--Aircraft Side, ARINC Characteristic 751, Jan. 1, 1994.
Aviation Week & Space Technology, "Safety Board Urges Mandatory Use of FDR/CVRs in Commuter Transports," Avionics, p. 73, McGraw-Hill, Inc., Aug. 31, 1987.
Aviation Week & Space Technology, "Conversion Approach Appears Flawed," Aerospace Business, vol. 139, No. 4, p. 48, McGraw-Hill, Inc., Jul. 31, 1993.
Electronic Engineering Times,"Module is Result of Work With Apple--Plessey Makes Leap With Wireless LAN," Nov. 7, 1994.

ART-UNIT: 2636

PRIMARY-EXAMINER: Crosland; Donnie L.

ATTY-AGENT-FIRM: Allen, Dyer, Doppelt, Milbrath & Gilchrist, P.A.

ABSTRACT:

A system and method provides a retrievable record of the flight performance of the aircraft and includes a ground data link unit that obtains flight performance data representative of aircraft flight performance during flight of the aircraft. A spread spectrum transceiver is coupled to a data store and operative to download flight performance data that has been accumulated and stored by the data store over a spread spectrum communication signal. A ground base spread spectrum transceiver receives the spread spectrum communication signal from the aircraft and demodulates the signal to obtain flight performance data. A wireless unit is operative with the ground data link unit. This wireless unit could be for inventory control of products during in-flight servicing of passengers.

26 Claims, 18 Drawing figures

Previous Doc Next Doc Go to Doc#

L7: Entry 2 of 3 File: USPT Jun 1, 2004

DOCUMENT-IDENTIFIER: US 6745010 B2
TITLE: Wireless, frequency-agile spread spectrum ground link-based aircraft data communication system with wireless unit in communication therewith

Brief Summary Text (2):
The present invention relates in general to communication systems, and is particularly directed to an aircraft data communication system having a plurality of wireless ground links that link respective aircraft-resident subsystems, in each of which a copy of its flight performance data is stored, with airport-located ground subsystems, each ground subsystem being coupled, in turn, by way of respective telco links to a remote flight operations control center, where flight performance data from plural aircraft parked at different airports may be analyzed and from which the uploading of in-flight data files may be directed by airline systems personnel.

Brief Summary Text (4):
Modern aircraft currently operated by the commercial airline industry employ airborne data acquisition (ADA) equipment, such as a digital flight data acquisition unit (DFDAU) as a non-limiting example, which monitor signals supplied from a variety of transducers distributed throughout the aircraft, and provide digital data representative of the aircraft's flight performance based upon such transducer inputs. As flight performance data is obtained by the acquisition equipment, it is stored in an attendant, physically robust, flight data recorder (commonly known as the aircraft's "black box"), so that in the unlikely event of an in-flight mishap, the flight data recorder can be removed and the stored flight performance data analyzed to determine the cause of the anomaly.

Brief Summary Text (5):
In a further effort to improve aircraft safety, rather than wait for an accident to happen before analyzing flight recorder data, the Federal Aviation Administration (FAA) has issued a draft advisory circular AC-120-XX, dated Sep. 20, 1995, entitled "Flight Operational Quality Assurance Program" (FOQA), which recommends that the airlines look at the information provided by the digital flight data acquisition unit at regular intervals.

Brief Summary Text (6):
One suggested response to this recommendation is to equip each aircraft with a redundant flight data recording unit having a removable data storage medium, such as a floppy disc. Such an auxiliary digital data recorder is intended to allow aircraft safety personnel to gain access to the flight performance data by physically removing the auxiliary unit's data disc, the contents of which can then be input to an aircraft performance analysis data processing system for evaluation.

Brief Summary Text (7):
Although installing such a redundant flight data recording unit allows airline personnel to retrieve a copy of the flight performance data for subsequent evaluation, when considering the large volume of aircraft traffic experienced by major commercial airports, the above-proposed scheme is not only extremely time and manpower intensive, but is prone to substantial misidentification and aircraft/data

association errors.

Brief Summary Text (10):
In accordance with the present invention, the above-described objective of periodically analyzing flight performance data, without having to physically access a redundant unit on board the aircraft, is successfully addressed by means of a wireless ground data link, through which flight performance data provided by airborne data acquisition equipment is stored, compressed, encrypted and downloaded to an airport-resident ground subsystem, which forwards flight performance data files from various aircraft to a flight operations control center for analysis. For purposes of providing a non-limiting example, in the description of the present invention, the data acquisition equipment will be understood to be a DFDAU.

Brief Summary Text (15):
The airport base station forwards flight performance data files from various aircraft by way of a separate communications path such as a telephone company (telco) land line to a remote flight operations control center for analysis. The airport base station automatically forwards flight summary reports, and forwards raw flight data files, when requested by a GDL workstation.

Brief Summary Text (16):
The flight operations control center, which supports a variety of airline operations including flight operations, flight safety, engineering and maintenance and passenger services, includes a system controller segment and a plurality of FOQA workstations through which flight performance system analysts evaluate the aircraft data files that have been conveyed to the control center.

Detailed Description Text (9):
The airport base station 202 is coupled via a local communications path 207, to which a remote gateway (RG) segment 206 is interfaced over a communications path 230, to a central gateway (CG) segment 306 of a remote flight operations control center 300, where aircraft data files from various aircraft are analyzed. As a non-limiting example communications path 230 may comprise an ISDN telephone company (telco) land line, and the gateway segments may comprise standard LAN interfaces. However, it should be observed that other communication media, such as a satellite links, for example, may be employed for ground subsystem-to-control center communications without departing from the scope of the invention.

Detailed Description Text (10):
The flight operations control center 300 includes a system controller (SC) segment 301 and a plurality of GDL workstations (WS) 303, which are interlinked to the systems controller 301 via a local area network 305, so as to allow flight performance systems analysts at control center 300 to evaluate the aircraft data files conveyed to the flight operations control center 300 from the airport base station segments 202 of the ground subsystem 200.

Detailed Description Text (12):
The system controller 301 has a server/archive terminal unit 304 that preferably includes database management software for providing for efficient transfer and analysis of data files, as it retrieves downloaded files from a ground subsystem. As a non-limiting example, such database management software may delete existing files from a base station segment's memory once the files have been retrieved.

Detailed Description Text (13):
In addition, at a respective ground subsystem 200, for a given aircraft, a batch file may be written into each directory relating to that aircraft's tail number, type and/or airline fleet, so that a GDL unit on board the aircraft will be automatically commanded what to do, once a ground data link has been established with a ground subsystem's wireless router. The systems analyst at a respective GDL workstation 303 in the flight operations control center may initially request only

a copy of the exceedence list portion of the flight parameter summary report. Should the report list one or more parameter exceedences, the system analyst may access the entire flight performance file relating to such parameter exceedences.

Detailed Description Text (19):
As will be described, on each of a plurality of sub-band channels of the unlicensed 2.4-2.5 GHz S-band segment of interest, a wireless router 201 continuously broadcasts an interrogation beacon that contains information representative of the emitted power level restrictions of the airport. Using an adaptive power unit within its transceiver, the GDL unit 111 on board the aircraft responds to this beacon signal by adjusting its emitted power to a level that will not exceed communication limitations imposed by the jurisdiction governing the airport. The wireless (RF) transceiver 26 then accesses the compressed flight performance data file stored in memory 24, encrypts the data and transmits the file via a selected sub-channel of the wireless ground communication link 120 to wireless router 201. The sub-channel selected is based upon a signal quality monitoring mechanism, as will be described. The recipient wireless router 201 forwards the data file to the base station segment for storage; further, the flight summary file is automatically transmitted over the communications path 230 to the remote flight operations control center 300 for analysis.

Detailed Description Text (57):
As will be appreciated from the foregoing description, the objective of satisfying the FAA's current airline Flight Operations Quality Assurance program, which recommends that airlines routinely analyze aircraft data, is successfully addressed in accordance with the present invention by means of a frequency-agile wireless ground data link, that uses a reasonably wide unlicensed portion of the EM spectrum, does not require physically accessing the aircraft, and supplies the same aircraft data provided by the airborne data acquisition unit in a compressed and encrypted format, that is automatically downloaded to an airport-resident base station segment, when the aircraft lands. When polled by a remote flight operations control center, the base station segment then forwards aircraft data files from various aircraft over a communication path such as a telco land line to the flight operations control center for analysis.

Current US Cross Reference Classification (6):
701/14

CLAIMS:

23. A method according to claim 18, and further comprising the step of downloading and uploading data over a spread spectrum communications signal that is modulated with forward error correction.

Previous Doc Next Doc Go to Doc#

L7: Entry 3 of 3 File: USPT Apr 20, 2004

US-PAT-NO: 6725137
DOCUMENT-IDENTIFIER: US 6725137 B2

TITLE: Method and apparatus using historical data to associate deferral procedures and fault models

DATE-ISSUED: April 20, 2004

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
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Felke; Timothy J.	Glendale	AZ		

ASSIGNEE-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY	TYPE CODE
Honeywell International Inc.	Morristown	NJ			02

APPL-NO: 10/116182 [PALM]
DATE FILED: April 3, 2002

INT-CL: [07] G06 F 19/00

US-CL-ISSUED: 701/29; 701/35, 701/3, 244/75R
US-CL-CURRENT: 701/29; 244/75.1, 701/3, 701/35

FIELD-OF-SEARCH: 701/29, 701/35, 701/3, 244/75R

PRIOR-ART-DISCLOSED:

U.S. PATENT DOCUMENTS

Search Selected Search ALL Clear

	PAT-NO	ISSUE-DATE	PATENTEE-NAME	US-CL
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☐	5315502	May 1994	Koyama et al.	700/79
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FOREIGN PATENT DOCUMENTS

FOREIGN-PAT-NO	PUBN-DATE	COUNTRY	CLASS
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1079204	February 2001	EP	
1106504	June 2001	EP	
2312518	October 1997	GB	
WO 0131411	May 2001	WO	
WO 0131450	May 2001	WO	

ART-UNIT: 3661

PRIMARY-EXAMINER: Zanelli; Michael J.

ASSISTANT-EXAMINER: Gibson; Eric M

ABSTRACT:

A method of associating deferral procedures to a fault model for complex systems based on historical data, the method including the steps of: analyzing historical data for deferral information to identify deferral procedures; associating each of the deferral procedures with a corresponding one or more standard repairs; linking each of the standard repairs with a fault code; and associating each of the deferral procedures with one or more of the fault codes that were linked, respectively, with the one or more standard repairs to thereby provide a set of associations between deferral procedures and fault codes. The method may be implemented in a software program and the program may advantageously be employed in an aircraft maintenance and operations support system for automatically associating deferral procedures with an aircraft fault model based on historical data.

20 Claims, 7 Drawing figures

Previous Doc Next Doc Go to Doc#

L7: Entry 3 of 3 File: USPT Apr 20, 2004

DOCUMENT-IDENTIFIER: US 6725137 B2
TITLE: Method and apparatus using historical data to associate deferral procedures and fault models

Abstract Text (1):
A method of associating deferral procedures to a fault model for complex systems based on historical data, the method including the steps of: analyzing historical data for deferral information to identify deferral procedures; associating each of the deferral procedures with a corresponding one or more standard repairs; linking each of the standard repairs with a fault code; and associating each of the deferral procedures with one or more of the fault codes that were linked, respectively, with the one or more standard repairs to thereby provide a set of associations between deferral procedures and fault codes. The method may be implemented in a software program and the program may advantageously be employed in an aircraft maintenance and operations support system for automatically associating deferral procedures with an aircraft fault model based on historical data.

Brief Summary Text (4):
Complex systems comprising tens or hundreds of inter-related and inter-operating systems and subsystems, many which may be complex in there own right, present unique maintenance and service challenges. Examples of such complex systems include factories, major buildings, ocean-going vessels, power generation plants, and aircraft to name a few. Complex systems and the inter-related and inter-operational nature of the systems and subsystems thereof often require equally complex and disciplined maintenance and service programs. These programs usually include documentation or records of observed or indicated irregularities or discrepancies and actions taken or services performed pursuant to resolution or prevention of such irregularities and discrepancies. This documentation is usually filled out, completed, or recorded by service and maintenance personnel. Expert systems and tools that can standardize service and maintenance diagnoses, procedures, cost estimates and so on are highly desirable for the time savings and precision they can offer to an overall maintenance and operational support program.

Brief Summary Text (5):
In the aircraft industry fault codes have more recently come to be used to provide a mechanism to summarize the set of symptoms or syndrome that is reported for each distinct aircraft fault condition. A fault code typically corresponds to a fault condition in a single system on the aircraft and can be used as the basis of fault isolation, material planning and deferral/criticality analysis. Fault Codes are a critical element of a "Fault Model" for an aircraft that can be used to support an automated diagnostic and maintenance support system. Deferral Procedures for an aircraft, for example, identify the set of fault conditions for which that aircraft can still be safely operated. These procedures are typically recorded in the aircraft "Minimum Equipment List" (MEL) which is supplied by or derived from a list supplied by the aircraft manufacturer.

Brief Summary Text (6):
Honeywell International Inc. builds an automated expert system called

"AMOSS" (Aircraft Maintenance and Operations Support System) that uses fault codes as a standard element in structuring the maintenance activities for an airline and aircraft within that airline. This system also assists airline personnel in the determination of which Deferral Procedures are appropriate for a given fault condition. Airlines and other suppliers also build similar systems with some of this functionality. In order to provide this functionality, it is critical that the system records a linkage or association between system fault conditions, as represented through Fault Codes, and the Deferral Procedures that are relevant. Historically this linkage could only be derived through manual generation of the data for this relationship. This is a very time consuming and error prone activity that adds complexity to the maintenance and service procedures, increases costs, and reduces the precision of planning and cost analysis activities. Clearly a need exists for methods and apparatus for associating deferral procedures and standard fault codes based on historical data.

Brief Summary Text (8):
The instant invention in overview is a method of associating deferral procedures to a fault model for complex systems based on historical data. The method includes: analyzing the historical data for deferral information to identify a plurality of deferral procedures; associating each of the plurality of deferral procedures with a corresponding one or more of a plurality of standard repairs; linking each of the plurality of standard repairs with a fault code; and associating each of the plurality of deferral procedures with one or more of the fault codes that were linked, respectively, with the one or more of the plurality of standard repairs to thereby provide a set of associations between the plurality of deferral procedures and a plurality of fault codes.

Brief Summary Text (9):
Preferably, analyzing the historical data for deferral information to identify the plurality of deferral procedures further includes assigning a deferral procedure from a deferral procedure list to each occurrence of deferral information. Also a reference to the historical data may be maintained with each of the plurality of deferral procedures and each of the plurality of standard repairs. The process of associating the plurality of deferral procedures preferably further includes creating relationships between the plurality of deferral procedures and the plurality of standard repairs utilizing the historical data that is common between a deferral procedure and a standard repair. The act of linking the plurality of standard repairs likely includes selecting the fault code from a standard fault code list. The method may also include reviewing and accepting a portion of the set of associations. In a preferred form this method is used to associate deferral procedures to a fault model for an aircraft.

Detailed Description Text (6):
Referring to FIG. 1 a simplified and exemplary flow chart of a method 100 of associating deferral procedures with fault codes or to a fault model for complex systems based on historical data is depicted. The method begins at 101 where historical data, specifically log book pages from aircraft maintenance records or similar data from maintenance and service records for other complex systems is obtained. This historical data or logbook pages will be reviewed, analyzed, and parsed or broken down into relevant constituent elements that are likely system specific and then normalized to standardized texts or names for various elements. This will be discussed below in further detail for aircraft historical date with reference to FIG. 2.

Detailed Description Text (7):
Given this historical data step 103 shows analyzing the historical data or relevant portion thereof, specifically deferral information to identify a plurality of deferral procedures and step 105 shows a reference to a deferral procedure list for standardized deferrals, such as Deferral 1, that are preferably assigned to each of the unique deferral procedures or instances of unique deferral information

identified at step 103. This deferral procedure list comes from a minimum equipment list (MEL) that is derived from the OEM "Master Minimum Equipment List" in the aircraft industry. Preferably a reference or one or more references to the historical data is maintained for each of the plurality of deferral procedures. The log pages or corrective actions portions are also analyzed to group one or more corrective actions where the grouping function places similar corrective actions derived from the historical data in the same group or repair. The grouping activity can be performed using known techniques utilizing the Maintenance Manual Table of Contents (MM TOC) section titles as Standard Repairs and a combination of ATA Hierarchy nodes and MM TOC section titles for Standard Observations. Log page discrepancies and corrective actions are then mapped to Standard Observations and Standard Repairs respectively. Optionally, the results of this process are presented to a subject matter expert or engineer of ordinary skill for confirmation of the derived relationships. To enhance the quality of Standard Observations (e.g. AIR CONDITIONING), subject matter experts may be used to add Position, Symptom and Fault Condition information. Position information may be placed as a prefix to the Standard Observation (e.g. LEFT, RIGHT, Etc). Symptom information may be used to further describe the failure mode (e.g. INOP, ILLUMINATED, Etc). Fault Conditions describe the aircraft operational mode at the time of failure (e.g. IN FLIGHT, ON GROUND, Etc). A fully normalized Standard Observation could look as follows: LEFT AIR CONDITIONING INOP IN FLIGHT.

Detailed Description Text (8):
Step 109 refers to a standard repair list that reflects assigning a standard repair such as REPAIR 1 to each of the plurality of repairs or groups of corrective actions so derived. The standard repair list comes from Aircraft Maintenance Manual (AMM) in the aircraft industry. One approach is using the table of contents (TOC) as or to construct an index that is then used for the list of repairs. Also preferably for each instance where a corrective action is grouped with a repair a reference to the historical information or data is maintained. Thus each of the plurality of repairs will have one or more references to the historical data maintained therewith. These references to historical data can be a log page number or other standard reference to a maintenance record that includes or was used to derive the historical data.

Detailed Description Text (13):
FIG. 2 shows logbook pages being analyzed to determine the associated discrepancy and corrective actions attributes. Each log page contains a unique log page number 209 and aircraft number 211. The discrepancy data will be normalized into observation text and the observation ATA 213 can usually be derived directly from the log page data. In the aircraft industry ATA is short for an AIR TRANSPORT ASSOCIATION code that is hierarchical with a 2-digit code referring to an aircraft system and a 4-digit code referring to a sub-system. For example, engines and there sub-systems are documented in Chapters 71 to 80. Standard repair text is derived from a synthesis process using an index as in known to provide a list that allows corrective actions to be grouped. In many cases where applicable, deferral information for deferred maintenance and associated MEL Doc Ref and part information will also be found in the corrective action text.

Detailed Description Text (14):
A deferral normalization process analyzes the deferral text in the corrective action of the log page to identify the referenced Deferral Procedure 215, if any. This process uses the Deferral Procedure List to identify the format and valid strings for references to Deferral Procedures. The Deferral Procedure List includes any auxiliary formats or aliases that can be used to refer to or identify each Deferral Procedure, such as Deferral 1, etc in the log book pages. The result of this process is shown in tabular form in table 1 of FIG. 3. FIG. 3 indicates a listing of Deferral 301 and corresponding aircraft 303 and the reference to historical data or log page numbers 305. FIG. 3 also shows the associated standard repairs 307 that have been identified from the analysis of the corrective actions

on the log pages. The data within the rows of table 3 show each of the plurality of deferral procedures with a corresponding one or more of a plurality of standard repairs each from the standard repair list.

Detailed Description Text (17):
In the nature of a summary on aspect of the disclosed method is a software program comprising software instructions that is arranged to run on a processor to process information derived from historical data in order to facilitate associating deferral procedures to a fault model for complex systems based on the historical data. The software program when installed and operating on a processor results in the processor: analyzing the historical data for deferral information to identify a plurality of deferral procedures; associating each of the plurality of deferral procedures with a corresponding one or more of a plurality of standard repairs; linking each of the plurality of standard repairs with a fault code; and associating each of the plurality of deferral procedures with one or more of the fault codes that were linked, respectively, with the one or more of the plurality of standard repairs to thereby provide a set of associations between the plurality of deferral procedures and a plurality of fault codes.

Detailed Description Text (18):
The step or process of analyzing the historical data for deferral information to identify the plurality of deferral procedures further includes assigning a deferral procedure from a deferral procedure list to each instance of deferral information. Also a reference to the historical data is maintained with each of the plurality of deferral procedures and each of the plurality of standard repairs. Thus the process of associating the plurality of deferral procedures further includes creating relationships between the plurality of deferral procedures and the plurality of standard repairs utilizing the historical data that is common between a deferral procedure and a standard repair. The process of linking the plurality of standard repairs preferably includes selecting the fault code from a standard fault code list. Additionally a process of reviewing and accepting a portion of the set of associations is appropriate, particularly when the complex system is an aircraft and this method is part of or used to enhance part of a fault model for an aircraft.

Detailed Description Text (20):
The processes, discussed above, and the inventive principles thereof are intended to and will alleviate problems, such as inconsistent diagnostics and corrective actions or records thereof caused by prior art maintenance and service procedures for deferral processes. Using these principles of associating deferral procedures and fault codes will simplify service and maintenance procedures and save costs associated with inconsistent activities.

Current US Cross Reference Classification (2):
701/3

CLAIMS:

1. A method of associating deferral procedures to a fault model for complex systems based on historical data, the method including the steps of: analyzing the historical data for deferral information to identify a plurality of deferral procedures; associating each of said plurality of deferral procedures with a corresponding one or more of a plurality of standard repairs; linking each of said plurality of standard repairs with a fault code; and associating each of said plurality of deferral procedures with one or more off said fault codes that were linked, respectively, with said one or more of said plurality of standard repairs to thereby provide a set of associations between said plurality of deferral procedures and a plurality of fault codes.

2. The method of claim 1 wherein said step of analyzing the historical data for

deferral information to identify said plurality of deferral procedures further includes assigning a deferral procedure from a deferral procedure list to each deferral information.

8. A computer-readable storage medium containing computer-executable code to run on a processor to process information derived from historical data in order to facilitate associating deferral procedures to a fault model for complex systems based on the historical data, the computer executable code when installed and operating on a processor, instructing the processor to perform the steps of: analyzing the historical data for deferral information to identify a plurality of deferral procedures; associating each of said plurality of deferral procedures with a corresponding one or more of a plurality of standard repairs; linking each of said plurality of standard repairs with a fault code; and associating each of said plurality of deferral procedures with one or more of said fault codes that were linked, respectively, with said one or more of said plurality of standard repairs to thereby provide a set of associations between said plurality of deferral procedures and a plurality of fault codes.

9. The storage medium of claim 8 wherein said step of analyzing the historical data for deferral information to identify said plurality of deferral procedures further includes assigning a deferral procedure from a deferral procedure list to each deferral information.

15. An aircraft maintenance and operations support system for automatically associating deferral procedures with an aircraft fault model based on historical data, the system comprising in combination: a user interface; a computer, coupled to the user interface, having memory for storing software instructions and the historical data and a processor for; executing said software instructions to process information derived from the historical data in order to facilitate associating the deferral procedures to the aircraft fault model based on the historical data, the software program resulting in the computer; analyzing the historical data for deferral information to identify a plurality of deferral procedures; associating each of said plurality of deferral procedures with a corresponding one or more of a plurality of standard repairs; linking each of said plurality of standard repairs with a fault code; and associating each of said plurality of deferral procedures with one or more of said fault codes that were linked, respectively, with said one or more of said plurality of standard repairs to thereby provide a set of associations between said plurality of deferral procedures and a plurality of fault codes.

16. The system of claim 15 wherein said step of analyzing the historical data for deferral information to identify said plurality of deferral procedures further includes assigning a deferral procedure from a deferral procedure list to each deferral information.

Previous Doc Next Doc Go to Doc#

L1: Entry 1 of 2 File: USPT Jun 29, 2004

US-PAT-NO: 6757668
DOCUMENT-IDENTIFIER: US 6757668 B1
** See image for Certificate of Correction **

TITLE: Information fusion of classifiers in systems with partial redundant information

DATE-ISSUED: June 29, 2004

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APPL-NO: 09/704476 [PALM]
DATE FILED: November 3, 2000

PARENT-CASE:
CROSS REFERENCE TO RELATED APPLICATIONS The present application claims priority to Provisional Application U.S. Serial No. 60/163,723 filed Nov. 5, 1999.

INT-CL: [07] G06 F 17/00, G06 N 7/00, G06 N 7/08

US-CL-ISSUED: 706/59; 706/47, 706/61
US-CL-CURRENT: 706/59; 706/47, 706/61

FIELD-OF-SEARCH: 706/47, 706/59, 706/61

PRIOR-ART-DISCLOSED:

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	PAT-NO	ISSUE-DATE	PATENTEE-NAME	US-CL
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ART-UNIT: 2121

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ABSTRACT:

The present invention provides methods and tools to aggregate information stemming from a plurality of different classification tools and supportive evidential information to arrive at a unified classification estimate. The information fusion system according to the present invention has a plurality of sensors associated with the system, where each sensor is related to at least one class of the system and is data-related to the at least one class. A plurality of classification tools are each designed to receive selected and pre-processed outputs from the sensors and to generate classification outputs representing a state of at least one class

of the system. An information fusion tool is configured to receive the outputs of the classification tools as well as evidential information as inputs, and has an hierarchical architecture which manipulates the inputs to generate an output of aggregated fused information for a particular class of the system.

31 Claims, 14 Drawing figures

Previous Doc Next Doc Go to Doc#

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☐ 1. Document ID: US 20030191563 A1

Using default format because multiple data bases are involved.

L7: Entry 1 of 3 File: PGPB Oct 9, 2003

PGPUB-DOCUMENT-NUMBER: 20030191563
PGPUB-FILING-TYPE: new
DOCUMENT-IDENTIFIER: US 20030191563 A1

TITLE: Method and apparatus using historical data to associate deferral procedures and fault models

PUBLICATION-DATE: October 9, 2003

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US-CL-CURRENT: 701/29; 701/3

Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments | Claims | KWIC | Draw De

☐ 2. Document ID: US 6745010 B2

L7: Entry 2 of 3 File: USPT Jun 1, 2004

US-PAT-NO: 6745010
DOCUMENT-IDENTIFIER: US 6745010 B2

TITLE: Wireless, frequency-agile spread spectrum ground link-based aircraft data communication system with wireless unit in communication therewith

Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments | Claims | KWIC | Draw De

☐ 3. Document ID: US 6725137 B2

L7: Entry 3 of 3 File: USPT Apr 20, 2004

US-PAT-NO: 6725137
DOCUMENT-IDENTIFIER: US 6725137 B2

TITLE: Method and apparatus using historical data to associate deferral procedures and fault models

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Terms	Documents
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Previous Page Next Page Go to Doc#

L7: Entry 1 of 3 File: PGPB Oct 9, 2003

DOCUMENT-IDENTIFIER: US 20030191563 A1
TITLE: Method and apparatus using historical data to associate deferral procedures and fault models

Abstract Paragraph:
A method of associating deferral procedures to a fault model for complex systems based on historical data, the method including the steps of: analyzing historical data for deferral information to identify deferral procedures; associating each of the deferral procedures with a corresponding one or more standard repairs; linking each of the standard repairs with a fault code; and associating each of the deferral procedures with one or more of the fault codes that were linked, respectively, with the one or more standard repairs to thereby provide a set of associations between deferral procedures and fault codes. The method may be implemented in a software program and the program may advantageously be employed in an aircraft maintenance and operations support system for automatically associating deferral procedures with an aircraft fault model based on historical data.

Current US Classification, US Secondary Class/Subclass:
701/3

Summary of Invention Paragraph:
[0002] Complex systems comprising tens or hundreds of inter-related and inter-operating systems and subsystems, many which may be complex in there own right, present unique maintenance and service challenges. Examples of such complex systems include factories, major buildings, ocean-going vessels, power generation plants, and aircraft to name a few. Complex systems and the inter-related and inter-operational nature of the systems and subsystems thereof often require equally complex and disciplined maintenance and service programs. These programs usually include documentation or records of observed or indicated irregularities or discrepancies and actions taken or services performed pursuant to resolution or prevention of such irregularities and discrepancies. This documentation is usually filled out, completed, or recorded by service and maintenance personnel. Expert systems and tools that can standardize service and maintenance diagnoses, procedures, cost estimates and so on are highly desirable for the time savings and precision they can offer to an overall maintenance and operational support program.

Summary of Invention Paragraph:
[0003] In the aircraft industry fault codes have more recently come to be used to provide a mechanism to summarize the set of symptoms or syndrome that is reported for each distinct aircraft fault condition. A fault code typically corresponds to a fault condition in a single system on the aircraft and can be used as the basis of fault isolation, material planning and deferral/criticality analysis. Fault Codes are a critical element of a "Fault Model" for an aircraft that can be used to support an automated diagnostic and maintenance support system. Deferral Procedures for an aircraft, for example, identify the set of fault conditions for which that aircraft can still be safely operated. These procedures are typically recorded in the aircraft "Minimum Equipment List" (MEL) which is supplied by or derived from a list supplied by the aircraft manufacturer.

Summary of Invention Paragraph:
[0004] Honeywell International Inc. builds an automated expert system called "AMOSS" (Aircraft Maintenance and Operations Support System) that uses fault codes as a standard element in structuring the maintenance activities for an airline and aircraft within that airline. This system also assists airline personnel in the determination of which Deferral Procedures are appropriate for a given fault condition. Airlines and other suppliers also build similar systems with some of this functionality. In order to provide this functionality, it is critical that the system records a linkage or association between system fault conditions, as represented through Fault Codes, and the Deferral Procedures that are relevant. Historically this linkage could only be derived through manual generation of the data for this relationship. This is a very time consuming and error prone activity that adds complexity to the maintenance and service procedures, increases costs, and reduces the precision of planning and cost analysis activities. Clearly a need exists for methods and apparatus for associating deferral procedures and standard fault codes based on historical data.

Summary of Invention Paragraph:
[0005] The instant invention in overview is a method of associating deferral procedures to a fault model for complex systems based on historical data. The method includes: analyzing the historical data for deferral information to identify a plurality of deferral procedures; associating each of the plurality of deferral procedures with a corresponding one or more of a plurality of standard repairs; linking each of the plurality of standard repairs with a fault code; and associating each of the plurality of deferral procedures with one or more of the fault codes that were linked, respectively, with the one or more of the plurality of standard repairs to thereby provide a set of associations between the plurality of deferral procedures and a plurality of fault codes.

Summary of Invention Paragraph:
[0006] Preferably, analyzing the historical data for deferral information to identify the plurality of deferral procedures further includes assigning a deferral procedure from a deferral procedure list to each occurrence of deferral information. Also a reference to the historical data may be maintained with each of the plurality of deferral procedures and each of the plurality of standard repairs. The process of associating the plurality of deferral procedures preferably further includes creating relationships between the plurality of deferral procedures and the plurality of standard repairs utilizing the historical data that is common between a deferral procedure and a standard repair. The act of linking the plurality of standard repairs likely includes selecting the fault code from a standard fault code list. The method may also include reviewing and accepting a portion of the set of associations. In a preferred form this method is used to associate deferral procedures to a fault model for an aircraft.

Detail Description Paragraph:
[0019] Referring to FIG. 1 a simplified and exemplary flow chart of a method 100 of associating deferral procedures with fault codes or to a fault model for complex systems based on historical data is depicted. The method begins at 101 where historical data, specifically log book pages from aircraft maintenance records or similar data from maintenance and service records for other complex systems is obtained. This historical data or logbook pages will be reviewed, analyzed, and parsed or broken down into relevant constituent elements that are likely system specific and then normalized to standardized texts or names for various elements. This will be discussed below in further detail for aircraft historical date with reference to FIG. 2.

Detail Description Paragraph:
[0020] Given this historical data step 103 shows analyzing the historical data or relevant portion thereof, specifically deferral information to identify a plurality of deferral procedures and step 105 shows a reference to a deferral procedure list

for standardized deferrals, such as Deferral 1, that are preferably assigned to each of the unique deferral procedures or instances of unique deferral information identified at step 103. This deferral procedure list comes from a minimum equipment list (MEL) that is derived from the OEM "Master Minimum Equipment List" in the aircraft industry. Preferably a reference or one or more references to the historical data is maintained for each of the plurality of deferral procedures. The log pages or corrective actions portions are also analyzed to group one or more corrective actions where the grouping function places similar corrective actions derived from the historical data in the same group or repair. The grouping activity can be performed using known techniques utilizing the Maintenance Manual Table of Contents (MM TOC) section titles as Standard Repairs and a combination of ATA Hierarchy nodes and MM TOC section titles for Standard Observations. Log page discrepancies and corrective actions are then mapped to Standard Observations and Standard Repairs respectively. Optionally, the results of this process are presented to a subject matter expert or engineer of ordinary skill for confirmation of the derived relationships. To enhance the quality of Standard Observations (e.g. AIR CONDITIONING), subject matter experts may be used to add Position, Symptom and Fault Condition information. Position information may be placed as a prefix to the Standard Observation (e.g. LEFT, RIGHT, Etc). Symptom information may be used to further describe the failure mode (e.g. INOP, ILLUMINATED, Etc). Fault Conditions describe the aircraft operational mode at the time of failure (e.g. IN FLIGHT, ON GROUND, Etc). A fully normalized Standard Observation could look as follows: LEFT AIR CONDITIONING INOP IN FLIGHT.

Detail Description Paragraph:
[0021] Step 109 refers to a standard repair list that reflects assigning a standard repair such as REPAIR 1 to each of the plurality of repairs or groups of corrective actions so derived. The standard repair list comes from Aircraft Maintenance Manual (AMM) in the aircraft industry. One approach is using the table of contents (TOC) as or to construct an index that is then used for the list of repairs. Also preferably for each instance where a corrective action is grouped with a repair a reference to the historical information or data is maintained. Thus each of the plurality of repairs will have one or more references to the historical data maintained therewith. These references to historical data can be a log page number or other standard reference to a maintenance record that includes or was used to derive the historical data.

Detail Description Paragraph:
[0026] FIG. 2 shows logbook pages being analyzed to determine the associated discrepancy and corrective actions attributes. Each log page contains a unique log page number 209 and aircraft number 211. The discrepancy data will be normalized into observation text and the observation ATA 213 can usually be derived directly from the log page data. In the aircraft industry ATA is short for an AIR TRANSPORT ASSOCIATION code that is hierarchical with a 2-digit code referring to an aircraft system and a 4-digit code referring to a sub-system. For example, engines and there sub-systems are documented in Chapters 71 to 80. Standard repair text is derived from a synthesis process using an index as in known to provide a list that allows corrective actions to be grouped. In many cases where applicable, deferral information for deferred maintenance and associated MEL Doc Ref and part information will also be found in the corrective action text.

Detail Description Paragraph:
[0027] A deferral normalization process analyzes the deferral text in the corrective action of the log page to identify the referenced Deferral Procedure 215, if any. This process uses the Deferral Procedure List to identify the format and valid strings for references to Deferral Procedures. The Deferral Procedure List includes any auxiliary formats or aliases that can be used to refer to or identify each Deferral Procedure, such as Deferral 1, etc in the log book pages. The result of this process is shown in tabular form in table 1 of FIG. 3. FIG. 3 indicates a listing of Deferral 301 and corresponding aircraft 303 and the

reference to historical data or log page numbers 305. FIG. 3 also shows the associated standard repairs 307 that have been identified from the analysis of the corrective actions on the log pages. The data within the rows of table 3 show each of the plurality of deferral procedures with a corresponding one or more of a plurality of standard repairs each from the standard repair list.

Detail Description Paragraph:
[0030] In the nature of a summary on aspect of the disclosed method is a software program comprising software instructions that is arranged to run on a processor to process information derived from historical data in order to facilitate associating deferral procedures to a fault model for complex systems based on the historical data. The software program when installed and operating on a processor results in the processor: analyzing the historical data for deferral information to identify a plurality of deferral procedures; associating each of the plurality of deferral procedures with a corresponding one or more of a plurality of standard repairs; linking each of the plurality of standard repairs with a fault code; and associating each of the plurality of deferral procedures with one or more of the fault codes that were linked, respectively, with the one or more of the plurality of standard repairs to thereby provide a set of associations between the plurality of deferral procedures and a plurality of fault codes.

Detail Description Paragraph:
[0031] The step or process of analyzing the historical data for deferral information to identify the plurality of deferral procedures further includes assigning a deferral procedure from a deferral procedure list to each instance of deferral information. Also a reference to the historical data is maintained with each of the plurality of deferral procedures and each of the plurality of standard repairs. Thus the process of associating the plurality of deferral procedures further includes creating relationships between the plurality of deferral procedures and the plurality of standard repairs utilizing the historical data that is common between a deferral procedure and a standard repair. The process of linking the plurality of standard repairs preferably includes selecting the fault code from a standard fault code list. Additionally a process of reviewing and accepting a portion of the set of associations is appropriate, particularly when the complex system is an aircraft and this method is part of or used to enhance part of a fault model for an aircraft.

Detail Description Paragraph:
[0033] The processes, discussed above, and the inventive principles thereof are intended to and will alleviate problems, such as inconsistent diagnostics and corrective actions or records thereof caused by prior art maintenance and service procedures for deferral processes. Using these principles of associating deferral procedures and fault codes will simplify service and maintenance procedures and save costs associated with inconsistent activities.

CLAIMS:

1. A method of associating deferral procedures to a fault model for complex systems based on historical data, the method including the steps of: analyzing the historical data for deferral information to identify a plurality of deferral procedures; associating each of said plurality of deferral procedures with a corresponding one or more of a plurality of standard repairs; linking each of said plurality of standard repairs with a fault code; and associating each of said plurality of deferral procedures with one or more of said fault codes that were linked, respectively, with said one or more of said plurality of standard repairs to thereby provide a set of associations between said plurality of deferral procedures and a plurality of fault codes.

2. The method of claim 1 wherein said step of analyzing the historical data for deferral information to identify said plurality of deferral procedures further

includes assigning a deferral procedure from a deferral procedure list to each deferral information.

8. A software program comprising software instructions arranged to run on a processor to process information derived from historical data in order to facilitate associating deferral procedures to a fault model for complex systems based on the historical data, the software program when installed and operating on a processor resulting in the processor: analyzing the historical data for deferral information to identify a plurality of deferral procedures; associating each of said plurality of deferral procedures with a corresponding one or more of a plurality of standard repairs; linking each of said plurality of standard repairs with a fault code; and associating each of said plurality of deferral procedures with one or more of said fault codes that were linked, respectively, with said one or more of said plurality of standard repairs to thereby provide a set of associations between said plurality of deferral procedures and a plurality of fault codes.

9. The software program of claim 8 wherein said step of analyzing the historical data for deferral information to identify said plurality of deferral procedures further includes assigning a deferral procedure from a deferral procedure list to each deferral information.

15. An aircraft maintenance and operations support system for automatically associating deferral procedures with an aircraft fault model based on historical data, the system comprising in combination: a user interface; a computer, coupled to the user interface, having memory for storing software instructions and the historical data and a processor for; executing said software instructions to process information derived from the historical data in order to facilitate associating the deferral procedures to the aircraft fault model based on the historical data, the software program resulting in the computer: analyzing the historical data for deferral information to identify a plurality of deferral procedures; associating each of said plurality of deferral procedures with a corresponding one or more of a plurality of standard repairs; linking each of said plurality of standard repairs with a fault code; and associating each of said plurality of deferral procedures with one or more of said fault codes that were linked, respectively, with said one or more of said plurality of standard repairs to thereby provide a set of associations between said plurality of deferral procedures and a plurality of fault codes.

16. The system of claim 15 wherein said step of analyzing the historical data for deferral information to identify said plurality of deferral procedures further includes assigning a deferral procedure from a deferral procedure list to each deferral information.

Previous Doc Next Doc Go to Doc#